

EVOLUTIONARY ALGORITHMS



Gary Lamont

Professor

PhD, University of Minnesota,
1970

- Evolutionary Algorithms
- High Performance Parallel Computation
- Distributed Systems
- Artificial Intelligence
- Data Mining

e-mail: Gary.Lamont@afit.edu
phone: 937-255-3636 x 4718

The AFIT Genetic Computational Techniques (AGCT) Research Group is dedicated to developing and applying evolutionary algorithms to various optimization problems and associated military applications.

Evolutionary computation relates to models of biological self-adaptation processes involving operators as selection, mating (crossover) and mutation. From a computational viewpoint, the novel idea of evolutionary algorithms includes a variety of stochastic search algorithms including genetic algorithms, evolutionary strategies, evolutionary programming, genetic programming, and classifier systems. AFIT became actively involved in parallel genetic algorithm research in the late 1980s as an extension of our ongoing research in solving NP-complete optimization problems. These problems usually involve minimization of single and multi-objective functions resulting in very large search spaces. We have emphasized parallel and distributed genetic algorithms, "messy" genetic algorithms, classifier systems, single and multi-objective problems, and formal evolutionary algorithm design. Each research effort directly involves application of various evolutionary algorithms to Air Force problems of interest.

AFIT's current parallel and distributed genetic algorithm implementations are based on our previous models. Our research accomplishments in this area include the design, analysis, implementation, and empirical study of parallel GAs, global selection operators, conditional migration operators, "Niching" strategies, local minimization techniques combined with genetic algorithms,

AGCT

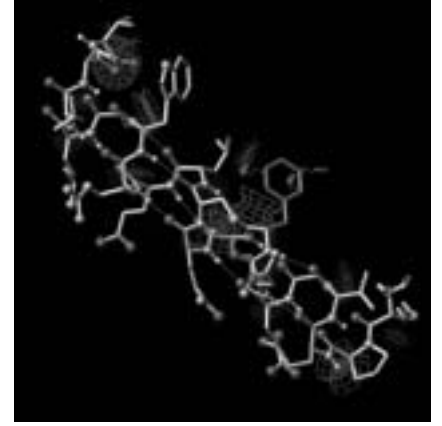
swarms and ant colony modeling, real-valued vs. binary EAs representation issues for single and multi-criteria optimization, formal models of evolutionary algorithms, optimal search parameters, self-organizing algorithms, domain knowledge for constraining GA search , and development of general and specific multiobjective GAs.

Our applications of Evolutionary Algorithms include the areas of Bayesian Reasoning, bioinformatics (protein structure prediction), data mining, task scheduling, unpiloted aerospace vehicle (UAV) clustering systems, remediation of contaminated groundwater, optimization of intrusion detection and computer virus immune systems, and many others. Because of the interdisciplinary nature of the area, AFIT professors from a variety of academic departments consider the application of EAs to a spectrum of problems (see sidebar).

The major courses involved with evolutionary computation are CSCE686 which introduces many deterministic and stochastic (GAs) algorithms for solving large scale optimization problems; CSCE886 focuses entirely on understanding and analyzing the various types of evolutionary algorithms. Associated laboratory work is done on a variety of computational platforms from PCs to workstations to our “Beowolf” cluster in the Parallel and Distributed Computational Laboratory.

As within any interdisciplinary research area including development and application of evolutionary algorithms, considerable effort is focused on mathematical modeling and analysis of algorithmic techniques and associated statistical evaluation of validation testing and comparison of our evolutionary algorithms to specific problem domains.

DNA



Operation Research

Prof James W. Chrissis
Prof Richard F. Deckro
Prof James T. Moore

Environmental Engineering

Prof Mark N.Goltz

Electrical Engineering

Prof Steven C. Gustafson

Computer Science/Engineering

Prof Gregg H. Gunsch